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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/644,247	08/20/2003	Naoharu Nishio	N24182902E	6087

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EXAMINER	
VOCKRODT, JEFF B	

ART UNIT	PAPER NUMBER
2822	

DATE MAILED: 04/09/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/644,247	NISHIO ET AL.	
	Examiner	Art Unit	
	Jeff Vockrodt	2822	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *21 August 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-18* is/are rejected.

7)☒ Claim(s) *19 and 20* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

This office action is in response to the application papers filed on 8-21-03. Claims 1-20 are pending.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 15-16 and 18 are rejected under 35 U.S.C. 102(b) as being anticipated by US 2002/0105066 A1 ("Eikyu").

Claim 15, unlike claim 1, does not require the first and second conductivity type implants to be formed in any particular order.

Eikyu teaches forming a gate electrode (5); implanting a first conductivity type (n-type phosphorous, Fig. 8F) at 30-50KeV at an angle that is different than 45° in which channeling does not occur (¶ 0077); implanting a second conductivity type (n-type arsenic, Fig. 8E) at about 100KeV at an angle of 45° to promote channeling (¶ 0075).

Claim 16. Eikyu teaches that implanting using a tilt angle of 45° with respect to the (100) surface of a silicon substrate (¶ 0055).

Claim 18. The second conductivity As forms a pocket implant pattern (9, Fig. 8E).

Claims 1, 3-5, and 6 are rejected under 35 U.S.C. 102(b) as being anticipated by US 6,306,712 ("Rodder").

Claims 1, 3, 4, 5. Rodder teaches a first low energy implant of arsenic at 10-20keV (col. 4, ll. 23-25); a second angled implant (15-45°) of indium at 60-170keV (col. 4, ll. 35-45). As shown in Fig. 2B, both implant steps are masked by the gate structure. Rodder does not teach the crystalline orientation of the substrate.

Jerman teaches that (100) silicon is the preferred orientation for MOS devices because the etch rate of (111) planes is low. (col. 1, ll. 25-29). Other reasons are known in the prior art for selecting (100) silicon relative to (111) silicon including for ease of cleaving dies from a substrate. Based on the foregoing, one of ordinary skill in the art would understand Rodder to be using a (100) oriented silicon substrate since that is the most common type of substrate for forming MOS devices and if anything else were used one would have expected the reference to state that explicitly. In addition, the teaching of Jerman would have motivated a person of ordinary skill in the art to choose a (100) silicon substrate.

It would have been obvious to one of ordinary skill in the art at the time of the invention to specify a (100) oriented silicon substrate such that the implant angle of 50° taught by Rodder would be perpendicular to a (001) face. One of ordinary skill in the art would have been motivated to provide a (100) wafer because these types of wafers are preferable for forming devices on a silicon substrate as taught by Jerman and to make it easier to separate individual dies from the wafer after processing.

Claim 6. The implanted species are annealed (col. 4, ll. 63-67).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claim 17 rejected under 35 U.S.C. 103(a) as being unpatentable over Eikyu in view of U.S. 5,336,625 ("Tong").

Eikyu is discussed above in relation to claims 15-16 and 18. Claim 17 differs from Eikyu by requiring implantation at an angle of 7-20°, whereas Eikyu merely teaches implanting at an angle different than 45° so that channeling does not occur.

Tong teaches that implanting into silicon at an angle of 7 degrees prevents channeling (col. 2, ll. 31-36).

It would have been obvious to one of ordinary skill in the art at the time of the invention to implant at 7 degrees in Eikyu (for the non-45° implant) to prevent channeling as suggested by Tong.

Claims 1, 6, and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over US 5,376,566 ("Gonzalez") in view of Jerman.

Claim 1. Gonzalez teaches a first ion implantation at 30-60KeV of arsenic using an IGFET (13) as a mask (Fig. 4); a second ion implantation step (after the first) of arsenic at 80-120KeV at an implant angle of 50° relative to normal of the silic0on substrate.

Gonzalez does not expressly state that the implant is perpendicular relative to a 001 face, but Gonzalez does teach implanting at 50° relative to the surface of the semiconductor substrate. Gonzalez differs from the claimed invention in that the orientation of the substrate is not specified to be (100).

Jerman teaches that (100) silicon is the preferred orientation for MOS devices because the etch rate of (111) planes is low. (col. 1, ll. 25-29). Other reasons are known in the prior art for selecting (100) silicon relative to (111) silicon including for ease of cleaving dies from a

substrate. Based on the foregoing, one of ordinary skill in the art would understand Gonzalez to be using a (100) oriented silicon substrate since that is the most common type of substrate for forming MOS devices and if anything else were used one would have expected the reference to state that explicitly. In addition, the teaching of Jerman would have motivated a person of ordinary skill in the art to choose a (100) silicon substrate.

It would have been obvious to one of ordinary skill in the art at the time of the invention to specify a (100) oriented silicon substrate such that the implant angle of 50° taught by Gonzalez would be perpendicular to a (001) face. One of ordinary skill in the art would have been motivated to provide a (100) wafer because these types of wafers are preferable for forming devices on a silicon substrate as taught by Jerman and to make it easier to separate individual dies from the wafer after processing.

Claim 6. Gonzalez teaches activating the dopants (col. 4, last paragraph).

Claim 7. Gonzalez does not teach annealing by rapid thermal annealing. Official notice is taken that rapid thermal annealing is a notoriously well know process for thermally activating implanted dopants. It would have been obvious to one of ordinary skill in the art at the time of the invention to activate the implanted ions in the process of Gonzalez using rapid thermal annealing.

Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Gonzalez and Jerman as applied to claims 1, 6, and 7 above, and further in view of Hause.

Claim 2. Gonzalez teaches implanting an angled implant from two different directions (Fig. 5). It appears that one would have to rotate the wafer in order to accomplish this.

Hause teaches that "shadowing" can be avoided by rotating the transistor structure during the implant process. (col. 6, ll. 10-12).

It would have been obvious to one of ordinary skill in the art at the time of the invention to rotate the wafer in the process of Rodder in order to implant on all sides of the gate and avoid a shadow effect as suggested by Hause.

Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Rodder in view of U.S. 5,780,902 ("Komuro").

Claim 8 differs from Rodder by requiring a third implantation step of the first conductivity type dopant to a level that is deeper and at a higher concentration than the first implant step. Rodder teaches deep source drain regions, but does not teach implanting them.

Komuro, Fig. 11, shows that implanting a deep, N+ source region (15) formed after the formation of a p-type pocket implant is conventional. (col. 5, ll. 10-16--note the figure numbers do not correspond to the description in Komuro but the drawing labels do)

It would have been obvious to one of ordinary skill in the art at the time of the invention to utilize ion implantation in forming a deep source/drain region in Rodder. One of ordinary skill in the art would have been motivated to do this by Komuro's teaching that ion implantation is well known and desirable for forming deep implant regions after forming a pocket implant.

Claims 9-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Rodder in view of US 6,218,250 ("Hause").

Claims 9, 10, 11, 12, 13. Rodder teaches a first low energy implant of arsenic at 10-20keV (col. 4, ll. 23-25); a second angled implant (15-45°) of indium at 60-170keV (col. 4, ll. 35-45). As shown in Fig. 2B, both implant steps are masked by the gate structure. Rodder does not teach rotation of the substrate during the indium implant step. One of ordinary skill in the art would also recognize from Fig. 2C that the substrate must be rotated in order to implant into the gate from both of the directions shown. Nevertheless Hause is cited to explicitly teach this.

Hause teaches that "shadowing" can be avoided by rotating the transistor structure during the implant process. (col. 6, ll. 10-12).

It would have been obvious to one of ordinary skill in the art at the time of the invention to rotate the wafer in the process of Rodder in order to implant on all sides of the gate and avoid a shadow effect as suggested by Hause.

Claim 14. Rodder teaches a first arsenic implant and the angled implant results in pocket implant. Rodder further teaches annealing the dopants (col. 4, ll. 63-67).

Claims 9-10, 12, 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over US 5,270,227 ("Kameyama") in view of Jerman

Claims 9-10, 12, 13. Kameyama teaches implanting silicon (semiconductor crystal cubic structure) at an angle of about 45° (col. 5, ll. 49-61) using a transistor gate structure as a mask while rotating the wafer to continuously vary the implantation direction (col. 5, ll. 10-20).

Jerman teaches that (100) silicon is the preferred orientation for MOS devices because the etch rate of (111) planes is low. (col. 1, ll. 25-29). Other reasons are known in the prior art for selecting (100) silicon relative to (111) silicon including for ease of cleaving dies from a substrate. Based on the foregoing, one of ordinary skill in the art would understand Gonzalez to be using a (100) oriented silicon substrate since that is the most common type of substrate for forming MOS devices. Alternatively, the teaching of Jerman would have motivated a person of ordinary skill in the art to choose a (100) silicon substrate.

It would have been obvious to one of ordinary skill in the art at the time of the invention to specify a (100) oriented silicon substrate such that the implant angle of 50° taught by Gonzalez would be perpendicular to a (001) face. One of ordinary skill in the art would have been motivated to provide a (100) wafer because these types of wafers are preferable for

forming devices on a silicon substrate as taught by Jerman and to make it easier to separate individual dies from the wafer after processing.

Allowable Subject Matter

Claims 18-20 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claims 19-20 depend from claim 15. Eikyu is applied against claim 15 above. Eikyu teaches an implant of arsenic (Fig. 8E) that corresponds to the second implant of claim 15 and an implant of phosphorous (Fig. 8F) that corresponds to the first implant of claim 15. Claim 19 requires the impurity of the second conductivity type has a mass less than the impurity of the first conductivity type. Eikyu teaches the opposite as the impurity of the second conductivity type is arsenic, which has a mass that is larger than the mass of phosphorous. Nothing in Eikyu or the prior art of record teaches or suggests changing the implant conditions and/or dopants in order to meet the claimed limitations.

Conclusion

Any inquiry concerning communications from the examiner should be directed to Jeff Vockrodt at (571) 272-1848. The examiner can be reached on weekdays from 9:30 am to 5:00 pm EST. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian, can be reached at (571) 272-1852.

The fax number for official correspondence is (703) 872-9306. Unofficial communications to the examiner may be faxed to (571) 273-1848. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist at (703) 308-0956.

April 5, 2004
J. Vockrodt

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